

### **REMARKS**

The Office Action mailed on December 4, 2002, has been received and reviewed.

Claims 1-4, 6-22, 24-26, and 28-40 are currently pending in the above-referenced application. The Office has withdrawn claims 33-40 from consideration as being drawn to a nonelected species of invention. Claim 26 has been objected to for containing new matter. Each of claims 1-4, 6-22, 24-26, and 28-32 stands rejected.

Reconsideration of the above-referenced application is respectfully requested.

### **Information Disclosure Statement**

Please note that an Information Disclosure Statement was filed in the above-referenced application on December 14, 2000, but that an initialed copy of the PTO-1449 that accompanied that Information Disclosure Statement has not yet been returned to the undersigned attorney. It is respectfully requested that the information contained in the Information Disclosure Statement and cited on the accompanying PTO-1449 be considered and made of record in the above-referenced application and that an initialed copy of the PTO-1449 evidencing such consideration be returned to the undersigned attorney.

### **Objection to the Specification**

The Amendment dated August 28, 2002, has been objected to under 35 U.S.C. § 132 for introducing new matter into the above-referenced application. Specifically, the amendment to claim 26 to recite planarization of a polymeric solder mask material by chemical-mechanical polishing has been objected to for lacking support in the originally-filed specification.

Claim 26 has been canceled without prejudice or disclaimer, thus mooted the objection thereto.

**Rejections Under 35 U.S.C. § 112, Second Paragraph**

Claims 1-4, 6-22, 24-26, and 28-32 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

Independent claim 1 was rejected for reciting “a conductive structure” twice. The second occurrence of “a conductive structure” has been changed to “the conductive structure” to eliminate any confusion.

In addition, independent claim 1 was rejected for reciting that the desired height of a conductive structure is “substantially equal” to the thickness at which a layer comprising polymeric material is disposed over a substrate. The phrase “substantially equal” is permissible and definite when “one of ordinary skill in the art would know what [is] meant by ‘substantially equal.’” *Andrew Corp. v. Gabriel Electronics*, 847 F.2d 819, 6 USPQ2d 2010 (Fed. Cir. 1988), as cited in M.P.E.P. § 2173.05(b). In this case, one of ordinary skill in the art would know or be able to determine the range of differences between the height of conductive material or a conductive structure disposed within an aperture of a layer comprising polymeric material and the thickness of the layer when a particular conductive material-introduction process is employed. Thus, one of ordinary skill in the art would understand what is meant by the recitation that the height of conductive material within the aperture of a layer that comprises polymeric material is “substantially equal to” the thickness of the layer. As such, it is respectfully submitted that the recitation of “substantially equal” in independent claim 1 is in compliance with the definiteness requirement of the second paragraph of 35 U.S.C. § 112.

For these reasons, it is respectfully submitted that, under 35 U.S.C. § 112, second paragraph, independent claim 1 is in condition for allowance.

Independent claim 22 was rejected for reciting “a desired conductive structure height,” then “a conductive structure.” The recitation of “a conductive structure” has been replaced with “the conductive structure,” which should eliminate any confusion as to what structure corresponds in height to the thickness of the layer of solder mask material.

Independent claim 22 was also rejected for reciting that the desired height of the conductive structure is "substantially equal" to the thickness of the layer of solder mask material.

As the meaning of the phrase "substantially equal" could be determined and understood by one of ordinary skill in the art, it is respectfully submitted that this phrase does not render the subject matter of independent claim 22 indefinite under 35 U.S.C. § 112, second paragraph.

Therefore, it is respectfully submitted that, under 35 U.S.C. § 112, second paragraph, independent claim 22 is in condition for allowance.

Claims 22, 24-26, and 28-32 were rejected under the second paragraph of 35 U.S.C. § 112 because paragraph [0012] of the specification indicates that the term "solder mask" is expansive and not limiting. It is then pointed out that, for purposes of examination, "the term 'solder mask' is equivalent to anything that serves as a *mask* for forming 'conductive elements', not necessarily from solder." Office Action, page 4. The only objection to such construction of the term "solder mask" is that the mask is used to form "conductive structures," as recited in the claims, as well as other types of "conductive elements," as noted in the outstanding Office Action.

In the event that this construction of the term "solder mask" is acceptable, it does not appear that any changes to any of claims 22, 24-26, or 28-32 or argument are needed to overcome the 35 U.S.C. § 112, second paragraph, rejections of these claims.

In view of the foregoing, it is respectfully requested that the 35 U.S.C. § 112, second paragraph, rejections of claims 1-4, 6-22, 24-26, and 28-32 be withdrawn.

#### **Claim Objection**

Claim 26 has been objected to for reciting new matter. Claim 26 has been canceled without prejudice or disclaimer, thereby rendering the objection thereto moot.

**Rejections Under 35 U.S.C. § 102(b)**

Each of claims 1-4, 6-22, 24, 25, and 28-40 stands rejected under 35 U.S.C. § 102(b).

A claim is anticipated by 35 U.S.C. § 102 prior art only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.

*Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

The identical invention must be shown in as complete detail as is contained in the claim.

*Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Schwiebert

Claims 1, 4, 6-14, 17, 19-22, 24, 25, and 29-32 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,586,715 to Schwiebert et al. (hereinafter "Schwiebert").

Schwiebert describes a method of using a stencil to form solder bumps 338 on substrates. Col. 2, lines 45-47. Specifically, Schwiebert describes placing a solder mask 326 with multiple apertures 330 onto a substrate 320. Col. 6, lines 24 & 25. The apertures 330 of the solder mask 326 correspond to the locations of wettable regions 322 (i.e., contact pads) on substrate 320. Col. 6, lines 30-32; FIGs. 3A-3D. "The mask aperture 330 dimensions are generally (but are not required to be) somewhat larger than the dimensions of the wettable regions 322." Col. 7, lines 53-55. The apertures 330 of the solder mask 326 serve two purposes; namely, they act as reservoirs for the metal paste to be deposited and "act as a dam . . . to contain the paste until and during the reflow process." Col 6, lines 39-42. Notably, the solder mask 326 remains in place during both the deposition and re-flow processes. Col. 3, lines 45-47; col. 6, lines 40-42.

A dollop of metal paste is "squeezeed" into the solder mask 326 apertures 330. Col. 7, line 65, to col. 8, line 2; FIG. 3B. The solder paste is a metal powder mixed with a flux vehicle. Col. 8, lines 15-17.

The solder paste is re-flowed by heating the entire assembly, which includes the substrate 320, the solder mask 326, and the solder paste. Col. 9, lines 56-58; FIG. 3C. As the assembly is heated, metal spheres 334 of the solder paste melt and coalesce into a single sphere

or solder bump 338. Col. 9, lines 58-60. As the metal spheres 334 of the solder paste melt and coalesce, the solder moves out of contact with the surfaces of the apertures 330. *See* FIG. 1B; FIG. 3C; col. 5, lines 20-67.

In this regard, Schwiebert also describes that the distance a solder bump 338 pulls away from the surface of an aperture 330 of the solder mask 326, or "bump-to-mask clearance," may be determined by the equation  $c = (L - D)/2$ , where L is the size of an aperture 330 and D is the diameter of a re-flowed solder bump 338 within the aperture 330. Col. 5, lines 52-63.

Schwiebert illustrates such bump-to-mask clearance in FIG. 1B and FIG. 3C, which depict c as being the distance between a sidewall of an aperture 330 and the closest point on the surface of the solder bump 338. As shown and described by Schwiebert, the bump-to-mask clearance is clearly greater than zero.

Moreover, as the solder bump 338 pulls away from the sidewall of its corresponding aperture 330 as the solder bump 338 is being formed, the solder bump has a height h which exceeds the thickness of the solder mask 326. FIG. 1B.

Independent claim 1 of the above-referenced application recites a method of disposing a conductive structure on at least one contact pad on an active surface of a semiconductor device substrate. Among other things, the method of independent claim 1 includes "bonding . . . conductive material within [an] aperture" of a layer comprising polymeric material "to . . . at least one contact pad to form [a] conductive structure of substantially said desired height," which is "substantially equal to" the thickness of the layer that comprises polymeric material.

Schwiebert lacks any express or inherent description of a conductive structure disposal method which includes "bonding . . . conductive material within [an] aperture" of a layer comprising polymeric material "to . . . at least one contact pad to form [a] conductive structure" that has a height which is "substantially equal to" the thicknesses of the layer that comprises polymeric material. Instead, the description of Schwiebert is limited to methods for forming solder bumps 338 that have heights h which exceed the thickness of the solder masks 326 that are used in such methods.

It is, therefore, respectfully submitted that Schweibert does not anticipate each and every element of independent claim 1, as is required to maintain a rejection under 35 U.S.C. § 102(b) and, thus, it is submitted that independent claim 1 is allowable over Schweibert.

Claims 4, 6-14, 17, and 19-21 are each allowable, among other reasons, as depending either directly or indirectly from claim 1, which is allowable.

Claim 7 is additionally allowable since Schweibert lacks any express or inherent description that an aperture may be formed through a layer *prior to* disposing the layer on a substrate. Rather, the description of Schweibert is limited to forming apertures in polymer layers only *after* the layers have been applied to or formed on a substrate. Col. 7, lines 26-30.

Claim 13 is further allowable because Schweibert neither expressly nor inherently describes reducing a thickness of a layer comprising polymeric material to at least partially expose a lateral periphery of a conductive structure.

Claim 14 depends from claim 13 and is also allowable since Schweibert includes no express or inherent description that a layer of polymeric material may be only partially etched to reduce a thickness thereof. Instead, at col. 7, lines 36-39, Schweibert merely describes processes for *removing* mask materials.

It is respectfully submitted that claim 20 is allowable over Schweibert since the solder paste referred to in Schweibert is not an elastomer. The term "elastomer" is defined, for example, by The American Heritage College Dictionary (3<sup>rd</sup> ed. 1997) as "[a]ny of various polymers having the elastic properties of natural rubber." As the solder paste described in Schweibert merely includes a metal powder and a flux vehicle (col. 8, lines 15-17) and no polymer, it is not an elastomer.

Turning now to independent claim 22, a method of forming a solder mask is recited. The method of independent claim 22 includes, among other things, forming a layer of solder mask material which may be reduced in thickness "when [a] conductive structure has been at least partially formed" in an aperture thereof.

Schweibert does not expressly or inherently describe that any of the solder mask materials thereof may be reduced in thickness following use of the resulting solder mask to form one or more conductive structures. The American Heritage College Dictionary defines the term "remove" as: "3. To take off." The phrase "reduction in . . . thickness," in contrast, clearly indicates that some of the solder mask material of the layer will remain on the substrate.

It is, therefore, respectfully submitted that, under 35 U.S.C. § 102(b), independent claim 22 is allowable over Schweibert.

Each of claims 24, 25, and 29-32 is allowable, among other reasons, as depending either directly or indirectly from claim 22, which is allowable.

Claim 25 is additionally allowable since, as is well known in the art, planarization is a process that is subsequently conducted to a material layer to render the surface thereof substantially planar. Planarization is often used when deposition and spreading processes are incapable of forming a layer of material with a substantially planar surface. As Schweibert lacks any express or inherent description that a layer of solder mask material may be planarized, it is respectfully submitted that Schweibert does not anticipate each and every element of claim 25.

#### Carey

Claims 1-3 and 18 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,597,469 to Carey et al. (hereinafter "Carey").

Carey describes, among other things, a process for forming conductive structures, such as solder bumps 40' (*see* FIG. 10), on the conductors or pads 14 of a planar substrate 12, such as an integrated circuit or electronic package (col. 3, lines 49-57). While the solder 40 from which the solder bumps 40' are subsequently formed initially has about the same height as the polymeric layers 16 and 30, it "assume[s] a meniscus-like shape 40' only between wettable surfaces of pads or connections 14 and 120." Thus, when reflowed, the solder 40, the volume of which remains substantially constant, moves away from the nonwettable surfaces of layers 16 and 30 to form a

meniscus-like shape 40'. As is evident from a look at FIG. 10, this meniscus-like shape 40' has a height which well exceeds the combined thicknesses of layers 16 and 30.

Accordingly, it is respectfully submitted that Carey does not expressly or inherently describe a method of disposing a conductive structure on a contact pad in such a way that a conductive structure which has a height that is "substantially equal to" a thickness of a layer comprising polymeric material is formed, as recited in independent claim 1.

It is, therefore, respectfully submitted that Carey does not anticipate each and every element of independent claim 1 and that, under 35 U.S.C. § 102(b), independent claim 1 is allowable over Carey.

Claims 2, 3, and 18 are each allowable, among other reasons, as depending either directly or indirectly from claim 1, which is allowable.

#### Busacco

Claims 1, 13, 15, 16, 22, and 28 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,674,595 to Busacco et al. (hereinafter "Busacco").

Busacco describes a process for bonding a coverlay 12 to a substrate 14 of a flexible circuit board 10. In addition to the substrate 14, the flexible circuit board includes contact bumps 18 on a surface 16 of the substrate 14. The contact bumps 18 are formed by plating. Col. 2, lines 27-33. Additionally, the contact bumps 18 are formed prior to the placement of the coverlay 12 on the surface 16 of the substrate 14. Col. 3, lines 38-42. In the final structure, which is depicted in FIG. 1, the coverlay 12 has a thickness which is much less than the heights of the contact bumps 18 that protrude from the surface 16 of the substrate 14. *See also*, col. 3, lines 10-14.

With respect to the subject matter recited in independent claim 1 of the above-referenced application, Busacco neither expressly nor inherently describes "disposing a quantity of conductive material on [a] layer" comprising polymeric material "and permitting [the] conductive material to substantially fill . . . at least one aperture" within the layer. Moreover, Busacco lacks any express or inherent description of "bonding . . . conductive material within [the] aperture to .



... at least one contact pad" of a substrate over which the layer has been disposed "to form [a] conductive structure ..."

For these reasons, it is respectfully submitted that Busacco does not anticipate each and every element of independent claim 1, as is required to maintain a rejection under 35 U.S.C. § 102(b). Therefore, under 35 U.S.C. § 102(b), independent claim 1 is allowable over Busacco.

Claims 13, 15, and 16 are each allowable, among other reasons, as depending either directly or indirectly from claim 1, which is allowable.

With respect to the subject matter recited in independent claim 22, Busacco does not expressly or inherently describe "forming a layer of *solder mask material*" (emphasis supplied) on an active surface of a substrate or at least partially forming a conductive structure "in ... at least one aperture" of the layer.

As Busacco does not anticipate each and every element of independent claim 22, it is respectfully submitted that, under 35 U.S.C. § 102(b), independent claim 22 is allowable over Busacco.

Claim 28 is allowable, among other reasons, as depending from claim 22 and, further, because Busacco lacks any express or inherent description that the material of the contact bumps 18 may be softened or melted.

In view of the foregoing, withdrawal of the 35 U.S.C. § 102(b) rejections of claims 1-4, 6-22, 24, 25, and 28-32 is respectfully requested.

#### **Election of Species Requirement**

As independent claim 1 is allowable and reads on both Species II (elected) and Species I (not elected) it is respectfully submitted that claims 33-40, which read on Species I and have therefore been withdrawn from consideration, should also be allowed.

**CONCLUSION**

It is respectfully submitted that each of claims 1-4, 6-22, 24, 25, and 28-40 is allowable. An early notice of the allowability of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully Submitted,



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Enclosure: Version with Markings to Show Changes Made

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**IN THE CLAIMS:**

Please amend the claims as follows:

1. (Amended three times) A method of disposing a conductive structure on at least one contact pad on an active surface of a semiconductor device substrate, comprising:  
disposing a layer comprising polymeric material over the substrate;  
imparting said layer with a thickness substantially equal to a desired height of the conductive structure;  
forming at least one aperture through said layer to expose at least a portion of the at least one contact pad;  
disposing a quantity of conductive material on said layer and permitting said conductive material to substantially fill said at least one aperture;  
bonding said conductive material within said aperture to the at least one contact pad to form [a] the conductive structure of substantially said desired height; and  
at least partially exposing a lateral periphery of the conductive structure through said layer.

22. (Amended three times) A method of forming a solder mask, comprising:  
disposing a solder mask material comprising a polymer onto an active surface of a substrate;  
forming a layer of said solder mask material having a substantially consistent thickness on the active surface of said substrate, said thickness of said layer being substantially equal to a desired conductive structure height; and  
forming at least one aperture through said layer in a location corresponding to a location of at least one contact pad of said substrate to expose said at least one contact pad through said solder mask, said solder mask material facilitating a reduction in said thickness when [a] the conductive structure has been at least partially formed in said at least one aperture.